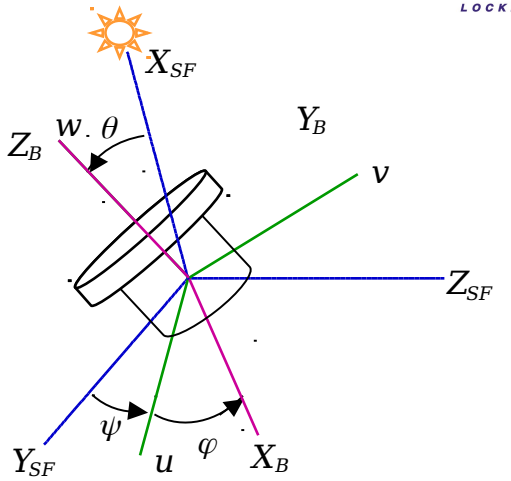
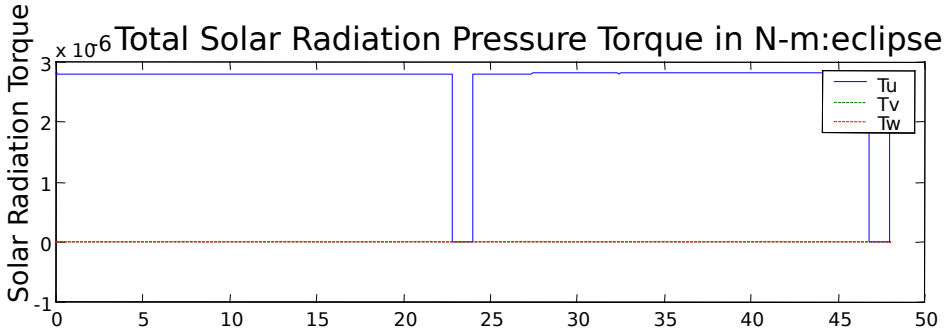
ACS Recovery Simulation During Eclipses (1 of 6)

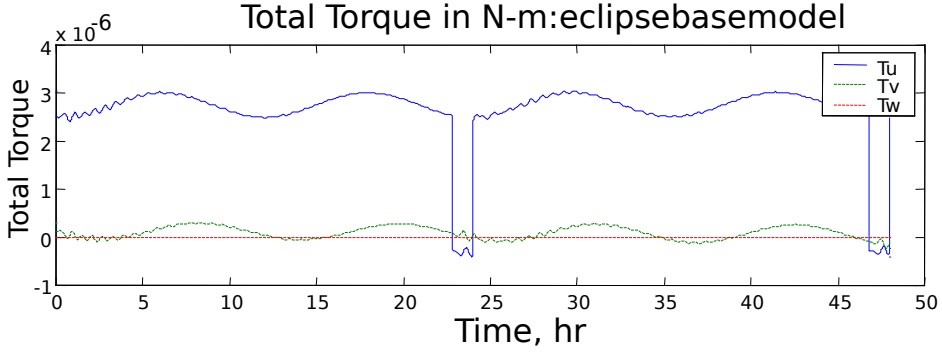
- Eclipse Season
  - Twice a year, lasts about 31 days per season
  - Eclipse occurs once a day, duration peaks at about 70 min.
- Eclipse Simulation
  - NRL FAME Simulator
  - Set solar radiation pressure to zero for 70 min. in every 24 hr orbit period
  - Two models evaluated:
    - Baseline model with gravity gradient torque only
    - Representative model (representative errors in mass property, optical property, geometry/deployment; gravity gradient and magnetic torque disturbances)
  - Not included:
    - Thermal radiation torque
    - Jitter due to thermal snap
    - Spin rate change due to s/c expansion/contraction
- Definition for ACS recovery
  - Nutation angle requirement: TBD
  - Cross-scan requirement: +/- 10 pixels in 1.56 sec
  - Spin rate variation requirement: +/- 0.262 μrad/sec over 300 sec

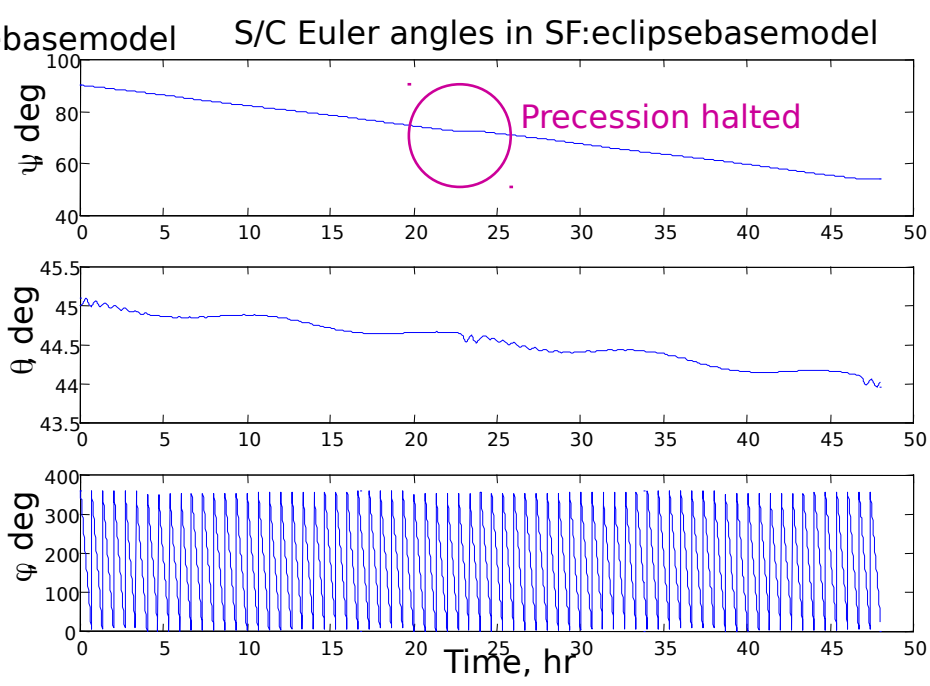
ACS Recovery Simulation During Eclipses (2 of 6)

- **S/C attitude behavior from the baseline model**
  - **Precession is halted during eclipse due to zero solar radiation pressure**
  - **Transient oscillations in sun angle immediately after the eclipse**



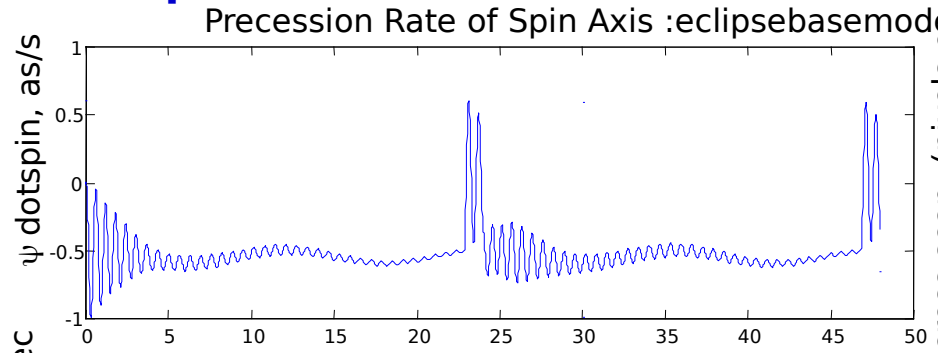


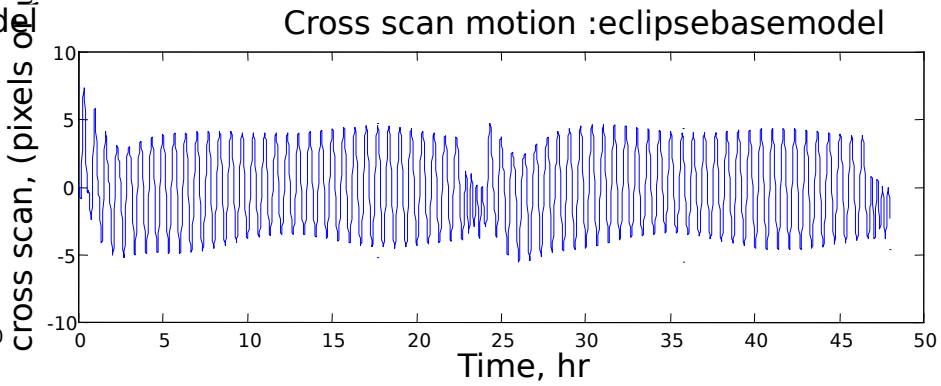


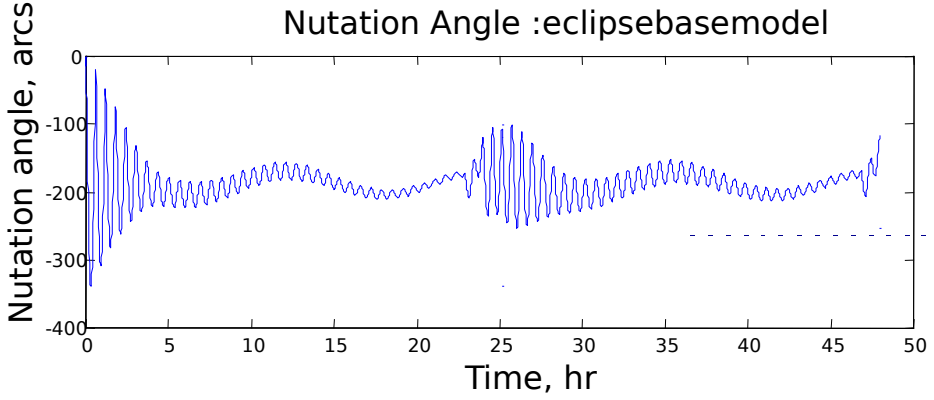


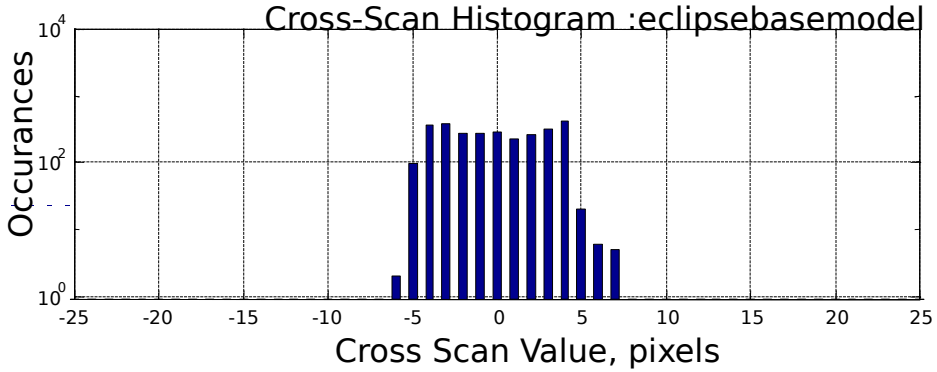
ACS Recovery Simulation During Eclipses (3 of 6)

- **S/C attitude behavior from the baseline model (cont.)**
  - **Transient oscillations visible in precession rate and nutation angle**
  - **Major transient nutation damps out in about 6 hours (rate feedback damping)**
  - **Cross-scan pixel motion stays within +/- 10 pixels during and immediately after the eclipse**
  - **Spin rate remains unaffected**



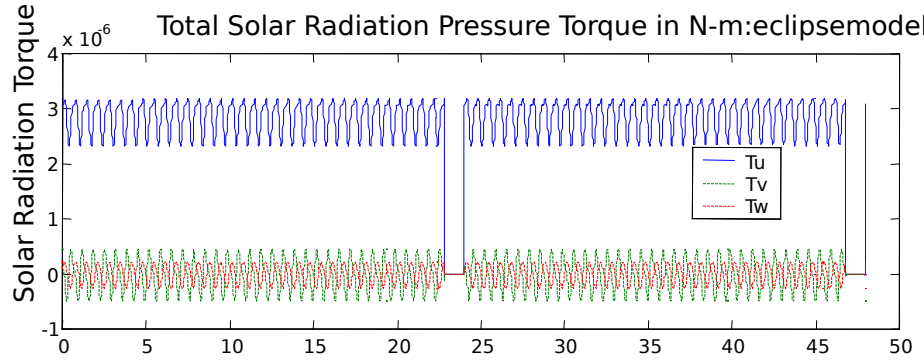


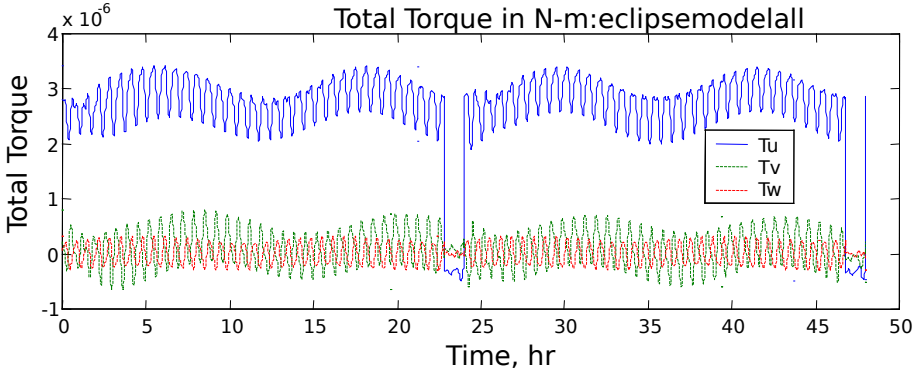


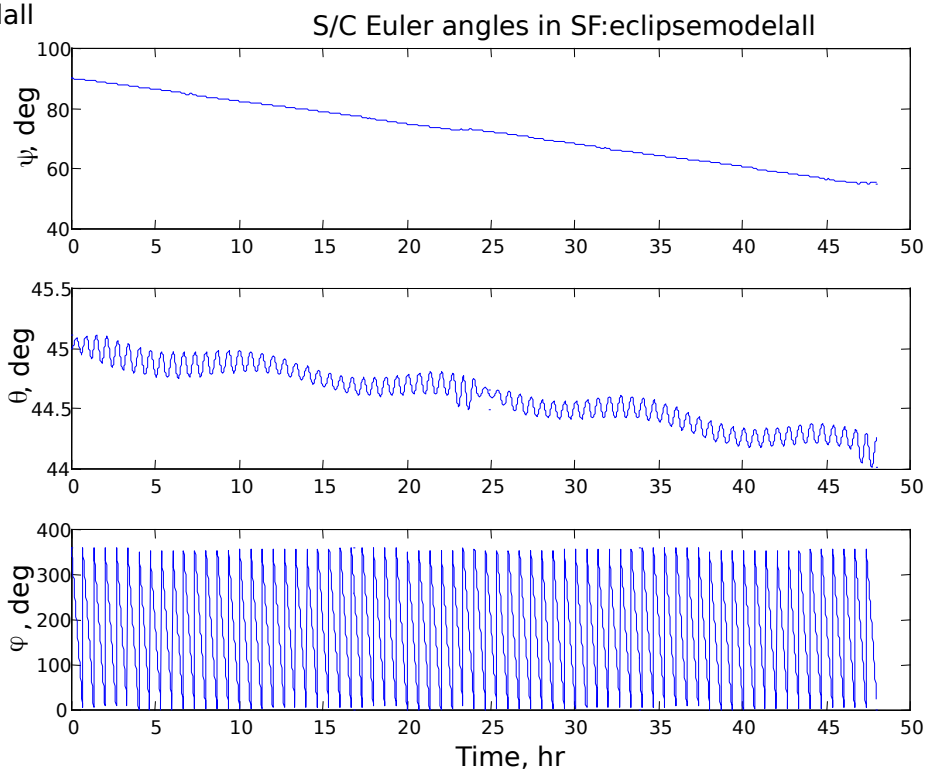


ACS Recovery Simulation During Eclipses (4 of 6)

- **S/C attitude behavior from the representative model**
  - **Precession is driven by disturbance torque other than solar radiation pressure during eclipse**
  - **Changes in oscillations in sun angle during and immediately after the eclipse**

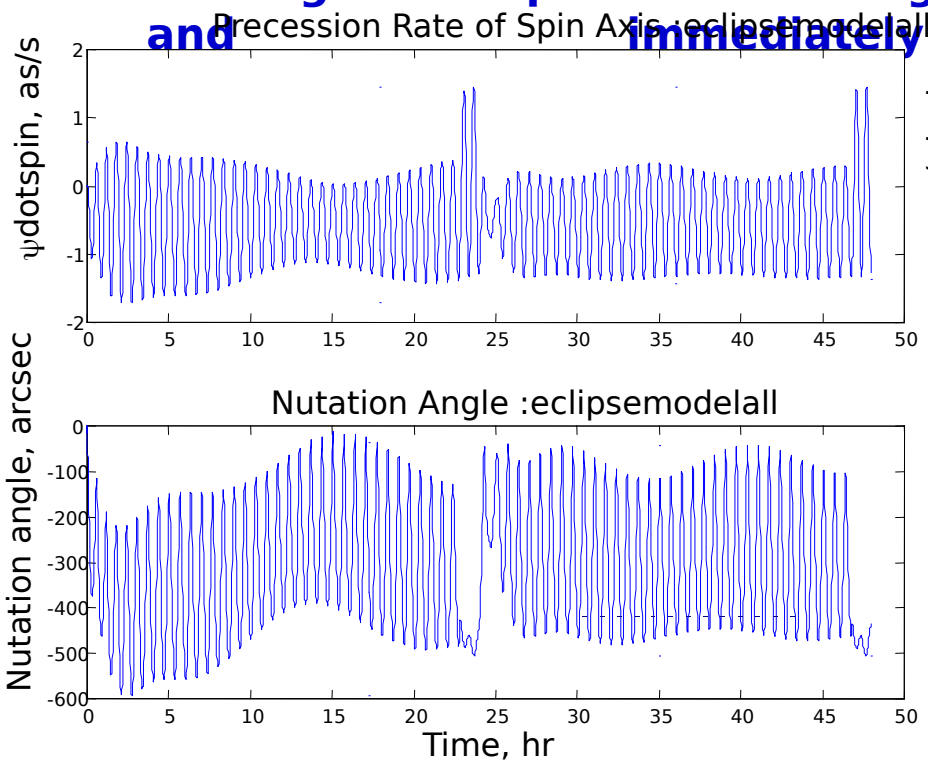


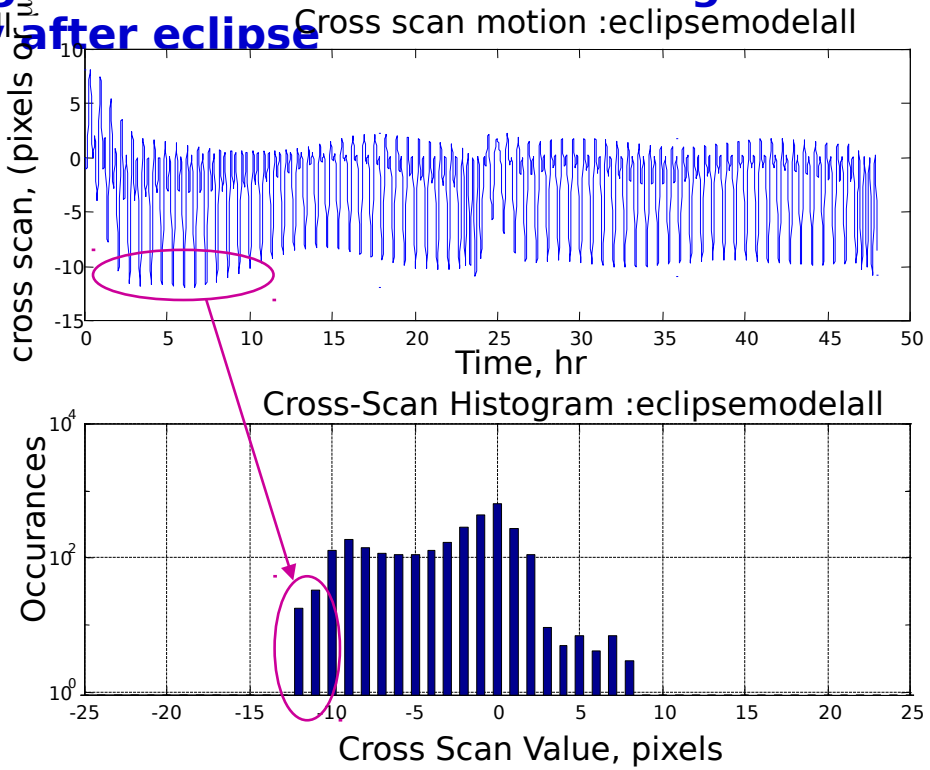




ACS Recovery Simulation During Eclipses (5 of 6)

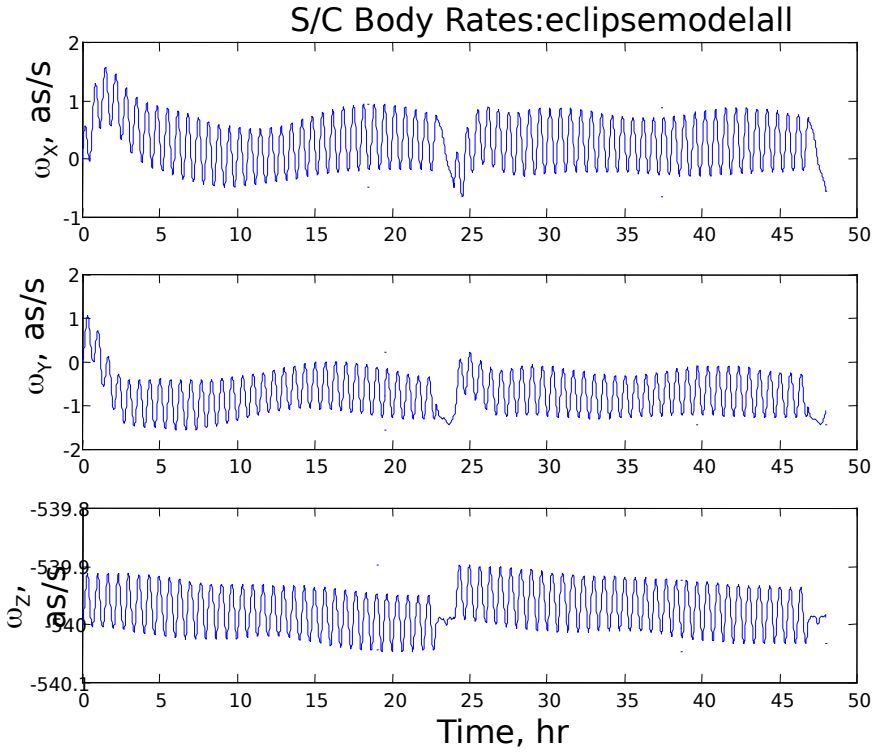
- **S/C attitude behavior from the representative model (cont.)**
  - **Nutation angle oscillation amplitude diminishes during eclipse due to precession rate bias change (from 0.5 as/s to 0 as/s)**
  - **No noticeable change in nutation angle pattern before and after eclipse**
  - **No significant performance degradation in cross-scan during and immediately after eclipse**

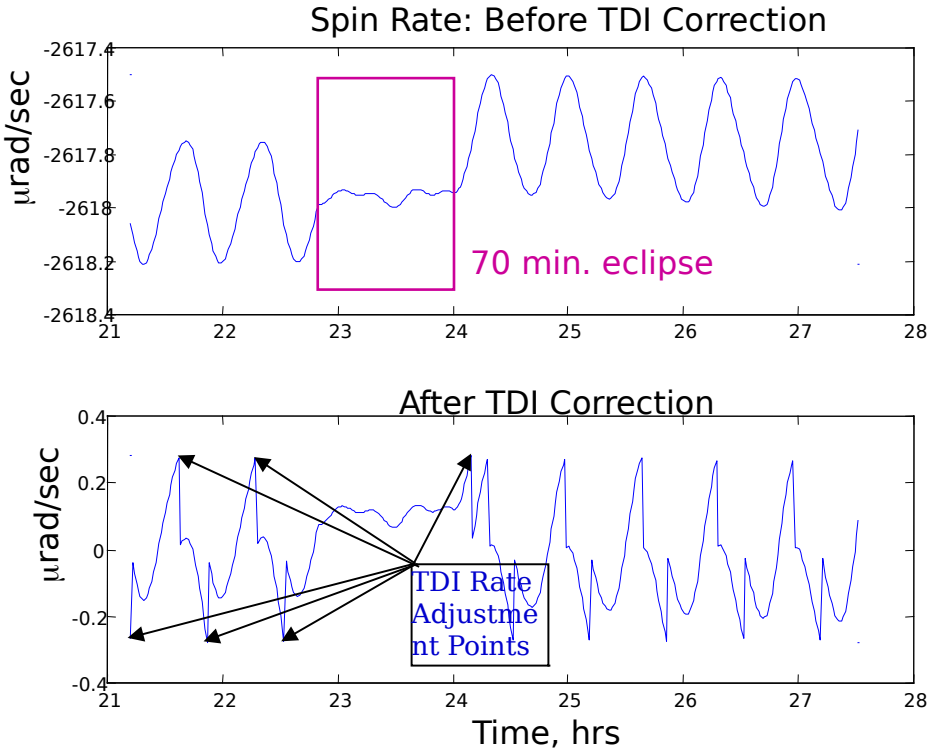




ACS Recovery Simulation During Eclipses (6 of 6)

- **S/C attitude behavior from the representative model (cont.)**
  - **Spin rate pattern resumes immediately after the eclipse**
  - **Spin rate oscillation is less during the eclipse**
  - **TDI rate adjustment is not needed during the eclipse**





Relationship Between Precession Rate Variation and Cross-Scan Error

- Relationship between precession rate and cross-scan pixel motion for a given time window (Δt):

$$P_{cross\_scan} = (\dot{\varphi}\sin\theta)(\cos\varphi)\Delta t \ (pixels \ or \ \mu rad)$$

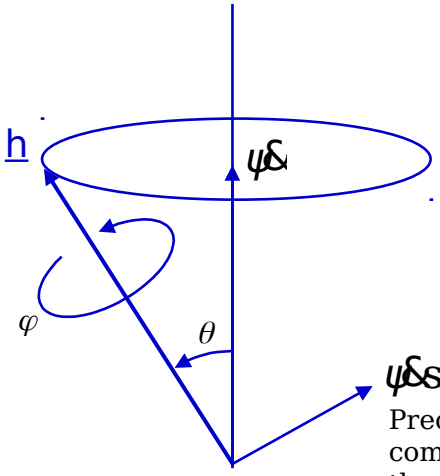
- For the precession period of 20 days with $\Delta t = 1.56$ sec (CCD crossing time)

$$P_{cross\_scan} = (3.64\mu rad/\sec)(\sin 45^o)(\cos\varphi)(1.56\sec) \ or$$

$$P_{cross\_scan} = 4.01(\cos\varphi) \ (pixels)$$

- Absolute maximum cross scan motion thus becomes

$$P^{\max}_{cross\_scan} = 4.01 \ (pixels)$$



Precession rate component normal to the spin axis